

# Extruded Platinum Coils from Recurrent Previously Coiled Intracranial Aneurysms Discovered at the Time of Microsurgical Clip Ligation

## A Report of Three Cases

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### Summary

*CE of brain aneurysms is safer with better outcomes than microsurgical clip ligation. However, the higher recurrence rate may nullify the acute benefits of coiling. Reported here are three patients who underwent surgery to treat their recurrent, previously coiled aneurysm. Intraoperatively, coils were seen extruding from the recurrent regions of each aneurysm and adherent to the surrounding neurovascular structures. These interesting findings question the premise that observation of a recurrent aneurysm is safe.*

### Introduction

Endovascular coil embolization of cerebral arterial aneurysms is reportedly safer with better outcomes, than surgical clip ligation<sup>1</sup>. Despite this, coil embolization has a higher incidence of incomplete obliteration, and recurrence rates have been reported to be higher (33% in two years) than microsurgical clip ligation (5% in seven years)<sup>2</sup>. Larger aneurysms treated with embolization fare even worse<sup>3,4</sup>. This higher incidence of incomplete obliteration and recurrence rate poses a risk of subarachnoid hemorrhage which may nullify the acute benefits of a safer procedure provided by endovascular techniques in some situations.

Here, three patients who had previously ruptured aneurysms treated with CE presented

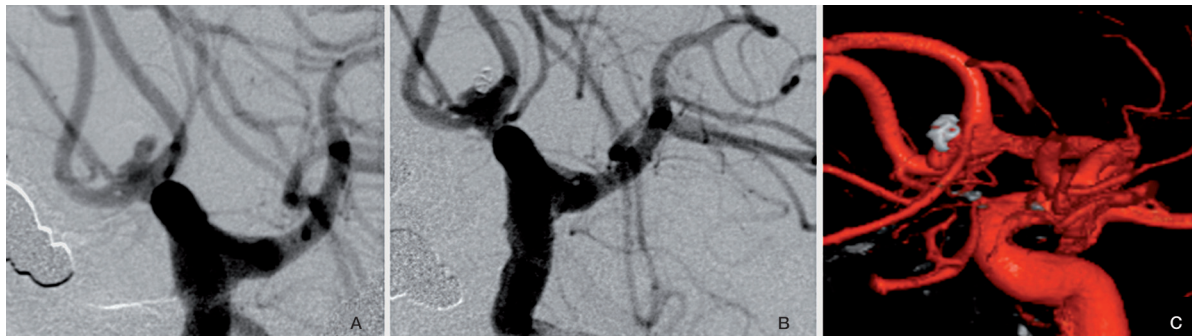
with recurrent aneurysms and chose to undergo microsurgical clip ligation as the definitive treatment. Interestingly, extruded coil segments were found in the regions of aneurysm recurrence.

### Case Reports

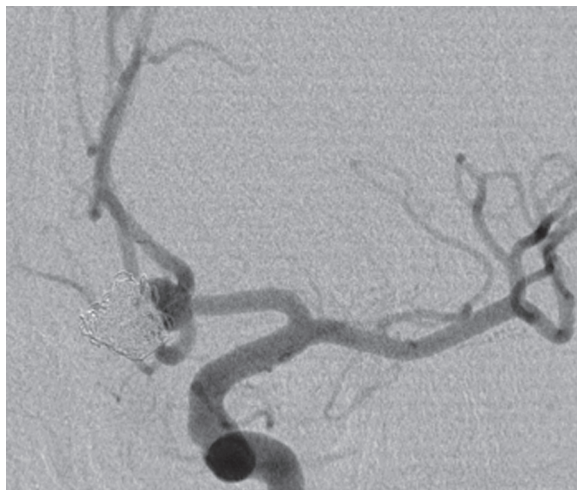
Three consecutive patients with previously ruptured intracranial aneurysms [2 a-com, 1 PICA] treated with coil embolization decided to undergo surgical clip ligation as the definitive treatment for their recurrent aneurysm (Table 1). In each case, recurrence was identified on routine follow-up digital subtraction angiography as filling of the neck and dome of the aneurysm (Figures 1-3). The PICA aneurysm had been previously coiled twice.

A standard pterional craniotomy was used to approach the two a-com artery aneurysms while a far lateral suboccipital craniotomy was used for the PICA aneurysm. In each case, prior to dissecting the aneurysm free from surrounding structures, extruded coil segments were found from both the obliterated region and more alarmingly from the recurrent necks and domes as well. Grossly, it appeared that the exit and entry points of the extruded coils were sealed by a thin transparent donut-hole-like membrane on the aneurysm while the extra-aneurysmal coil segments were completely bare.

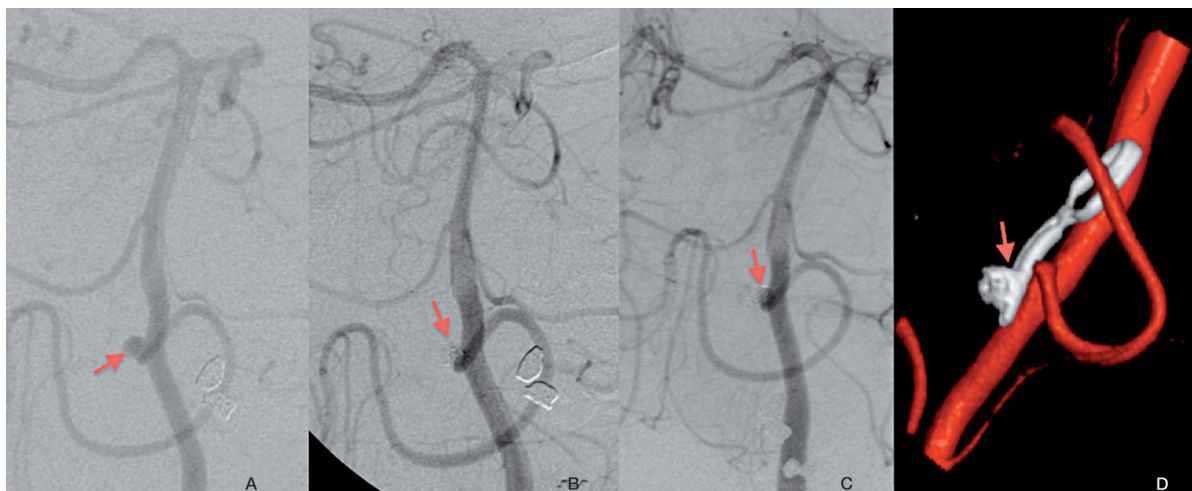
In each case, the extruded bare coils were ad-



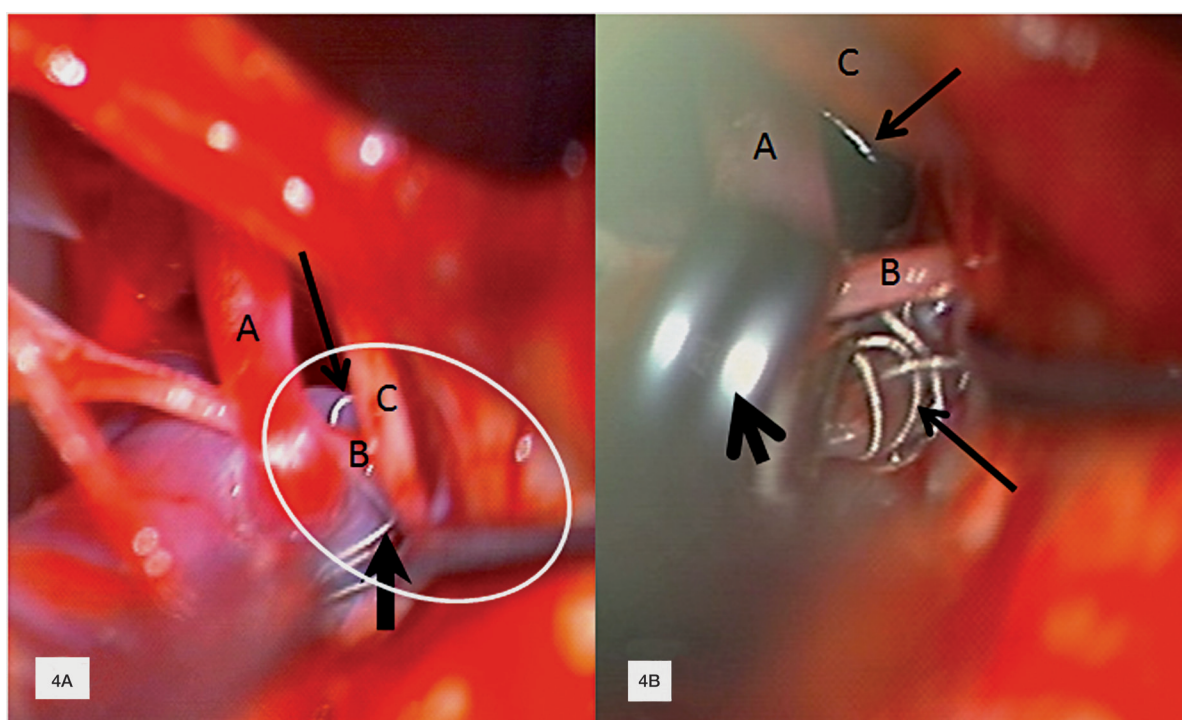
**Figure 1** Initial (A) and 6 month follow-up (B) digital subtraction angiography showing recurrence of the a-com aneurysm. Note that only the left lobe of this bilobed aneurysm was coiled initially because of the wide-neck. At 24 month follow-up (C) there was a recurrence of the neck and dome of the a-com aneurysm lobe that had been coiled previously seen here on 3D angiographic imaging; the uncoiled lobe persists but is stable.



**Figure 2** Five-year follow-up digital subtraction angiography showing recurrence of the a-com aneurysm. There is a large recurrence of the neck and proximal dome of the aneurysm. Also seen here is the compacted coil mass; immediate post-coiling angiogram available by report only.



**Figure 3** Pre-coiling (A), 12 month follow-up after first coil embolization (B), 12 month follow-up after second coil embolization (C), demonstrating persistent small recurrence of the aneurysm neck and dome of the PICA aneurysm. 18-month post-clipping 3D angiography (D) demonstrating complete occlusion of the aneurysm and preservation of PICA.



**Figure 4** A) PICA aneurysm exposed via a far lateral suboccipital approach. Lower cranial nerves (B, C) adherent to extruded coils (arrows) prior to dissection and clip ligation. B) Same surgical exposure, rotated slightly clockwise, now with lower cranial nerves (B,C) separated after being dissected free of extruded coils (small arrows) and PICA (A) aneurysm neck clipped (large arrow).

**Table 1** Characteristics of previously coiled aneurysms.

aneurysm location	previous SAH	original maximal diameter (mm)	original RROC	recurrence maximal diameter (mm)	follow-up RROC	timing of recurrence	no. of previous embolizations
A-COM (bi-lobed)	yes	5	1 (only suspected bleeding lobe coiled)	3	2 (coiled lobe)	2y	1
A-COM	yes	8	1	6.5	3	5y	1
PICA	yes	3	1	1.6	3	3y	2

herent to surrounding neurovascular structures and had to be carefully dissected free before clip ligation could be performed safely so as not to inadvertently clip these structures (Figures 4A,B and 5). The coils extruded from the PICA aneurysm were adherent to the glossopharyngeal nerve while those from the two a-com aneurysms were adherent to the gyrus rectus and the proximal left A-2 segment of the anterior cerebral artery, respectively. In keeping with the standard of care, these aneurysms were not removed from the patients, and no histological studies could be performed to eval-

uate the entry and exit zones of the extruded coil segments from the aneurysms.

## Discussion

Extruded platinum coils from these previously ruptured aneurysms force us to reassess the premise that observation of an incompletely embolized (“band-aid coiling”) or a partially recurrent aneurysm is safe. In particular, ISUIA-2 data revealed that complete obliteration occurs in only 55% of aneurysm emboliza-



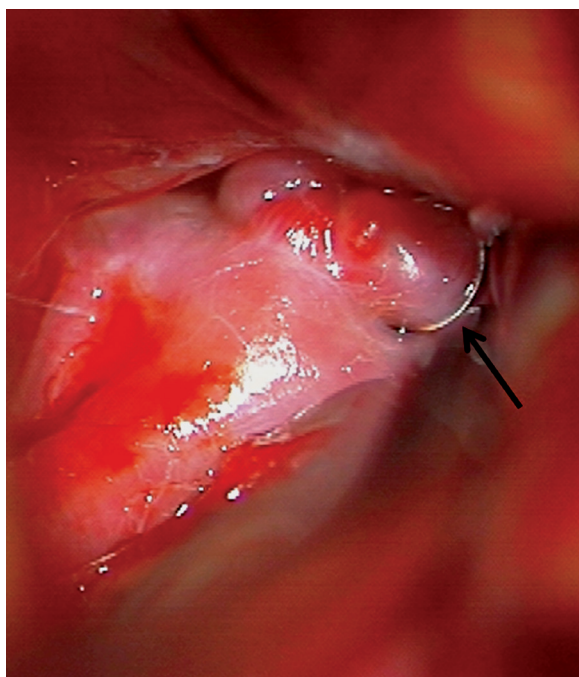


Figure 5 Recurrent bilobed a-com aneurysm with coil extrusion from the blood filled neck (arrow).

tions and ISAT had shown that aneurysmal rebleeds after embolization occurred in both incompletely and completely treated aneurysms<sup>1,5</sup>. The intra-operative findings of extruded platinum coils from regions of aneurysm where there was residual or recurrent blood flow raises the question of the safety of incomplete and recurrent, previously coiled aneurysms.

This question has been addressed recently in the long-term follow-up data from ISAT, where follow-up on patients between six and 14 years after entry into the trial were reviewed for rebleeding rates<sup>6</sup>. There were 13 rebleeds from the treated groups more than one year after treatment, ten of which were in the coiled group. Here, the authors demonstrated an increased risk of recurrent bleeding after coil embolization compared to surgical clip ligation, but the risk was small (0.01% per year). Therefore, though it may appear very concerning to the surgeon when coils are seen to be extruding from the aneurysm sac, long-term follow-up data from ISAT suggest that this may not be a significant risk to the patient.

The occurrence of extruded coils from aneurysms has also been reported more extensively by others, who reported their surgical experience with previously coiled aneurysms<sup>7</sup>. In this series, 43 patients underwent surgical treatment of coiled aneurysms that either recurred (22 patients) or were initially incompletely coiled

(21 patients). At the time of surgery, coil extrusion was seen in 5% (1/21) of the incompletely coiled aneurysms and 55% (12/22) of the recurrent aneurysms. They also concluded that coil extrusion is a time-dependent process and may be misdiagnosed on angiography simply as coil compaction. This case report also suggests that coil extrusion was not an acute event that occurred at the time of initial embolization given that there was no evidence of aneurysm rupture during the coiling procedures. Rather, coil extrusion was the end result of a slowly erosive process of the coil loop against the aneurysm wall, either from the outward radial force of the initial framing coils (particularly if the framing coil was oversized), or from repetitive pulsations of the coil mass from blood filling the aneurysm sac. This theory may be supported by the intra-operative findings of a thin membrane-like tissue surrounding the exit and entry zones of the coil from the aneurysm sac suggestive of a healing or scarring process.

All three of the recurrences reported here were in patients with a previous SAH from that aneurysm. Here, the Raymond-Roy Occlusion Classification (RROC) System was used to describe the completeness of aneurysm occlusion at the time of initial coiling and follow-up angiography<sup>4,8</sup>. Each aneurysm in this report was initially coiled completely with a RROC of "1" with the exception of the bilobed a-com aneu-

rysm that was wide necked. Here only the lobe suspected of bleeding could be coiled without compromising the parent a-com vessel (Table 1). The PICA aneurysm which was coiled twice had a RROC of "1" each time. All aneurysms recurred with a RROC of "2" or "3" prior to deciding that surgery was needed as the definitive treatment.

Observations made during microsurgical clip ligation of these three aneurysms demonstrated that there was actually more recurrence than suspected on the angiogram and was best demonstrated for the bilobed a-com aneurysm (Figure 5). These intra-operative observations

also suggest that incomplete and recurrent embolized aneurysms may not be safe to merely observe in some patients and retreatment either with further coil embolization or microsurgical clip ligation should be considered despite the low rebleed risk reported in the ISAT follow-up data<sup>5</sup>.

The timing and urgency of retreatment cannot be ascertained from the observations described here. Yet given these intra-operative findings, we should consider how to best identify which incompletely or recurrent coiled aneurysms are safe to observe and which require retreatment.

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